



## NOTE

### Notes on the immature stages of *Setabis* sp., a myrmecophagous riordinid butterfly (Lepidoptera: Riordinidae)

While visiting the state of Rondonia (Brazil), a curious butterfly larva was found in association with an unidentified ant species and subsequently reared to maturity on a diet of larvae and pupae of the Argentine ant, *Linepithema humile* (Mayr, 1868) (Hymenoptera: Formicidae). The adult, a female (Figs. 2 & 3), was identified as a member of the genus *Setabis* Westwood, 1851 (Lepidoptera: Riordinidae: tribe Nymphidiini), *vide* P.J. DeVries and D.J. Harvey, although without an associated male the specific taxon remains problematic. It appears to be at least near *S. lagus* (Cramer, 1777), and hereafter is referred to as *S. cf. lagus*. In addition to documenting the unusual diet of this insect in captivity, some morphological features of the last instar larva and pupa are reported.

The larva in question was given to the senior author by James Brock, who reported finding it “62 km S. Ariquemes, nr. Fazenda, Rancho Grande, 16 Nov. 1990” while investigating ant “carton shelters” on an unidentified shrub. The larva closely matched the dull mottled brown coloration of such shelters, which are often constructed over some riordinid larvae and honeydew-secreting homopterous insects (DeVries 1997; Ballmer pers. observ.). This larva was somewhat broad and dorso-ventrally compressed, while the prothorax was prolonged into a pair of short anterior extensions flanking and concealing the cranium; in habitus it closely resembled a larva of *S. lagus* illustrated by DeVries (1997), as well as larvae reported by Longino and Cover (2005) in association with *Pheidole biconstricta* Mayr (Hymenoptera: Formicidae).

The *S. cf. lagus* larva was initially confined within a 40 dram (147 ml) plastic vial with a leaf from the shrub on which it had been found. After three days, during which the larva crawled almost incessantly

without feeding on the leaf, a few larvae of *L. humile* were added to the vial. The *S. cf. lagus* larva fed on the ant larvae immediately upon encountering them. It continued to feed on ant brood when it was subsequently transferred to a petri dish (55 mm diameter) to which additional *L. humile* larvae, pupae, and worker ants were added, along with a small leaf on which the larva settled. All *L. humile* worker and immature ants were obtained from the same wild colony. Pupation occurred on 4 Dec. 1990 and eclosion was about two weeks later (exact duration not recorded). Initial notes on external larval and pupal morphology were supplemented, following adult eclosion, by microscopic examination of the larval and pupal exuviae.

The worker ants moved all the ant immatures to the leaf and piled them near the stationary *Setabis* larva, which subsequently ate them. The *S. cf. lagus* larva moved from its stationary position on the leaf only when prodded by the observer, but subsequently returned to its former position (Fig. 1). The larva continued to feed on ant brood and approximately doubled in size over the next few days; it eventually pupated on the same leaf, after which all remaining adult and immature ants were removed. The *L. humile* workers did not display any specific attendance behavior toward the *S. cf. lagus* larva, aside from placing ant larvae in close proximity to it.

Although the diet of the *S. cf. lagus* larva was not observed in the wild, its demonstrated capacity to subsist on a diet of immature *L. humile* ants suggests that myrmecophagy, as a brood parasite, may be a normal behavior. *Setabis lagus* is reported to feed on immature homopterous insects (Kaye, 1921; DeVries *et al.*, 1992) and to pupate gregariously within “carton shelters” near the associated ant nest entrance (DeVries, 1997). The life histories of other *Setabis* species have not been reported.

Myrmecophilous riordinid larvae possess various specialized cuticular organs to mediate their ant associations. Three such specific ant organs have been reported on larvae of nymphidiine riordinids (DeVries, 1988): 1) vibratory papillae on the prothorax generate substrate-borne vibrations which may attract ants (DeVries, 1990; 1991); 2) anterior tentacle organs (ATOs) on the metathorax are

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believed to release semiochemicals which mimic ant pheromones; 3) tentacle nectary organs (TNOs) on abdominal segment eight (A8) secrete a fluid which ants imbibe. Some immature riordinids, in common with lycaenids, also possess tiny cuticular perforated cupola organs (PCOs = lenticles of some authors) and delicately branched dendritic setae, whose functions remain speculative, but are often concentrated on body regions at or near foci of ant attendance (Ballmer & Pratt, 1991). Of these organs only TNOs were observed while the larva was alive. Eversion of the TNOs was observed only once and very briefly (for approximately one second) when the larva was prodded, and did not appear to be accompanied by any fluid secretion; nor was any concurrent behavioral response to the everted TNOs observed among nearby worker ants. The ants did not display any greater attention to the *Setabis* larva than to the ant larvae; nor did they exhibit aggression toward it.

A pair of vibratory papillae is present on the larval exuvia beneath the anterior extensions of the prothorax and directly above the cranium. The larval dorsum is densely covered with short, broad setae, varying from conical to mushroom-like in appearance and with a minutely granular surface appearance (MS in Fig. 4). The short, narrow base of this type of seta is recessed below the surrounding cuticle and best seen in profile in dislodged setae. Similar setae present on the cranium are most apparent on the frons and genae, gradually reduced in size and density dorsally, and virtually absent on the epicranium. The color of these setae (beige, brown, or black), their low reflectance, and their distribution pattern impart a dull mottled appearance similar to that of an ant "carton shelter." Setae of similar structure were illustrated by DeVries (1988) on the prothorax of *Thisbe irenea* (Stoll, 1780) larvae. More elongate, tapered tactile setae (Fig. 4) occur peripherally along the lateral fold, anterior margin of the prothorax, and lower portions of the cranium, especially near the oral margin.

A pair of slender tonosensillae ("sensory" setae *sensu* Ballmer & Pratt, 1988; also see discussion in Ballmer & Wright, 2008) is present anteriorly on the prothorax (SS in Fig. 4). These setae are easily distinguished from nearby tactile setae by their more slender shaft, somewhat greater length, recessed

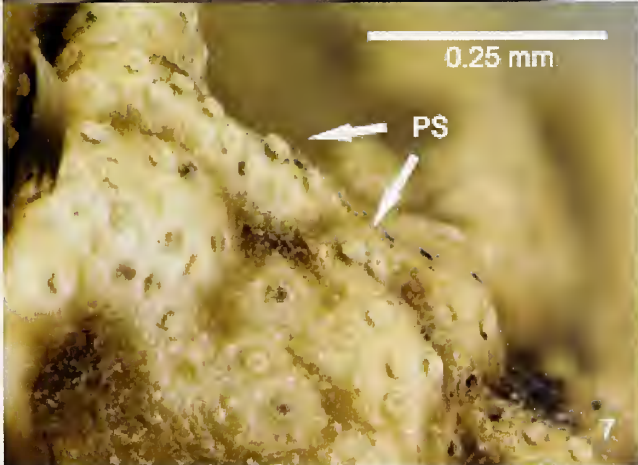
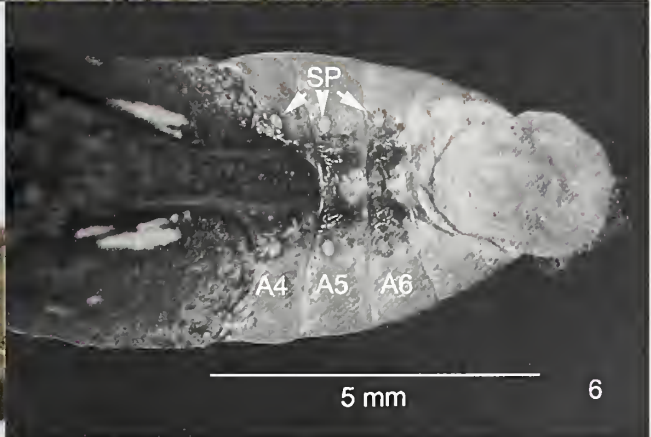
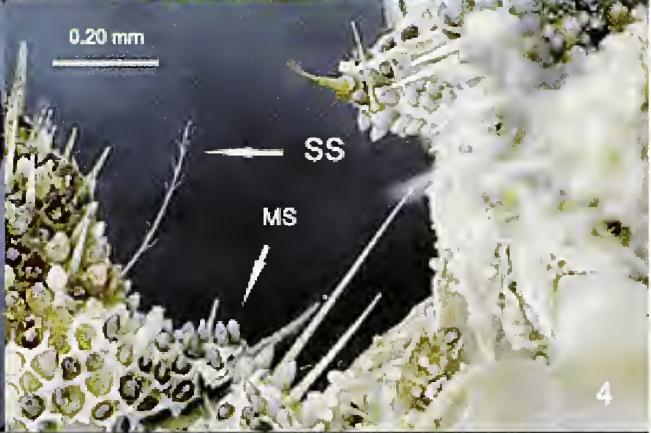
basal attachment, and slender lateral filaments. Structurally similar setae were reported for *Juditha caucana* larvae by Hall & Harvey (2002).

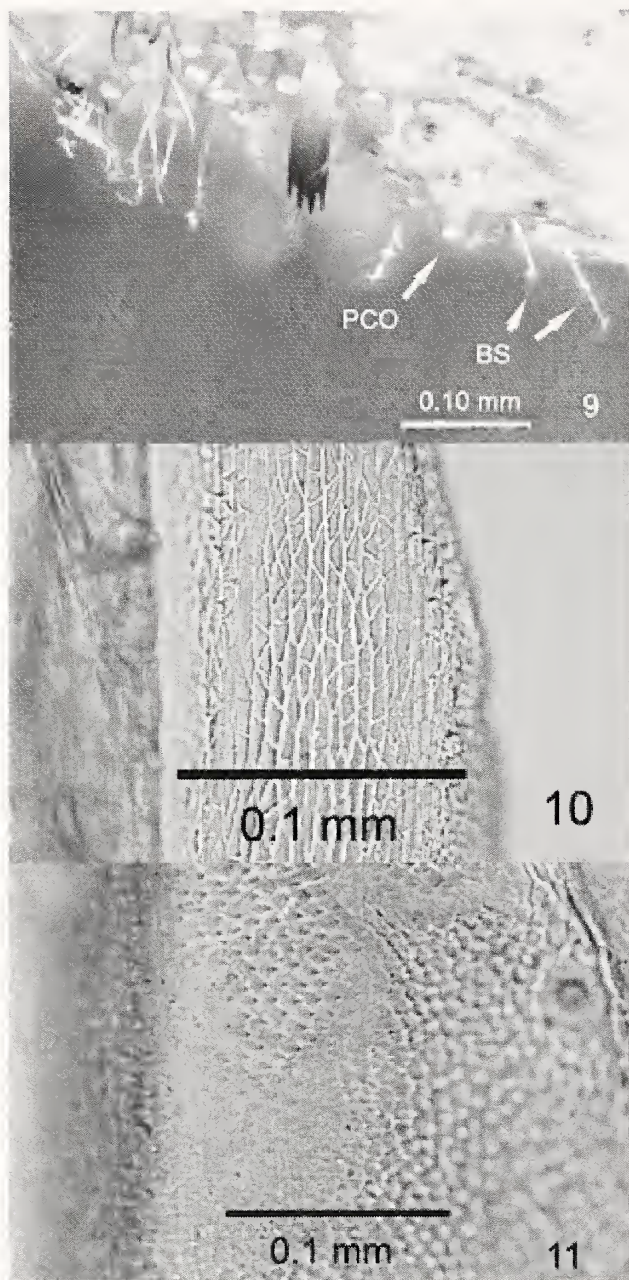
The *S. cf. lagus* pupa is roughly sculptured and rugose (Figs. 5 & 7), somewhat resembling that of *Thisbe irenea* (DeVries, 1997), generally mottled in earth-tones, but with olive green abdominal pleura. A silk girdle is lacking so that attachment to a silk pad on the substrate is only by cremastral hooks. The venter is somewhat arched and the fused segments A8-10 are expanded ventro-laterally into a broad, nearly circular structure. The central venter of the fused terminal segments is recessed, forming an inverted bowl structure in which only the rim contacts the substrate (Fig. 6). Although numerous cremastral hooks are distributed over the ventral surface of the fused terminal segments A8-10, they are absent from the recessed central portion and only those near the periphery engage strands of the silken pad.

The dorsal and lateral surfaces of the pupa appear macroscopically glabrous, but have scattered clusters of tiny parasol-like setae (PS in Fig. 7). The recessed bases of these setae are concealed by their flattened disk-like distal portions, which bear bar stool-shaped protuberances (Fig. 8). Somewhat similar (i.e. parasol-shaped) setae are present on pupae of some other Riordininae, including *Lyropteryx* Westwood, 1851 sp., *Melanis lycea* Hübner, 1823, and *Rhetus periander* (Cramer, 1777) (Ballmer, pers. observ.), and *Aricoris erostratus* (Westwood, 1851), as illustrated by Schremmer (1978). Although simple elongate tactile setae are not present, patches of about 20-30 slender, apically bifurcate setae (some perhaps trifurcate) are present in localized patches anterior to the T1 spiracles and subventrally on A5 admixed with PCOs (Fig. 9). The slender branched structure of these setae is similar to dendritic setae found on larvae and pupae of some lycaenids (see Ballmer & Pratt, 1988) and riordinids such as *Eurybia* [Illiger], 1807 (Ballmer & Pratt, 1991).

The arrangement of abdominal spiracles on the pupa is remarkable. Spiracles are not visible on A1, A3, A7, and A8, while the A2 spiracle is prominently visible laterally, just above the point of contact of that segment with the wing case. Spiracles on A4-6 are present ventrally and were observed only after the pupal exuvia was detached from its silken pad (Fig. 6). The

**Figures 1-8. (Opposite page). *Setabis cf. lagus*.** 1. *Setabis cf. lagus* larva with *Linepithema humile* adults and immatures. 2. Adult *Setabis cf. lagus* female. 3. Female *Setabis cf. lagus*, dorsum. 4. T-1 sensory (SS) and mushroom (MS) setae on larval exuvia. 5. *Setabis cf. lagus* pupa indicating sites of intersegmental stridulatory organs. 6. Pupal venter indicating spiracles on A4-6 and possible resonating chamber on fused A8-10. 7. Parasol setae (PS) on A6 dorsum of pupal exuvia. 8. SEM image of pupal parasol seta.





**Figures 9-11.** *Setabis cf. lagus*. **9.** Bifurcate setae (BS) & PCOs on pupal venter, A5. **10.** Stridulatory plate in intersegmental cleft, pupal dorsum, A4. **11.** Stridulatory file in intersegmental cleft, pupal dorsum, A5.

arched venter of the pupa in this region may facilitate air exchange with the spiracles. The absence of spiracles on pupal abdominal segments 1 and 3 is typical of many (perhaps most) genera of Riodiniinae, but not the Euselasiinae and Hamearinae (Hall *et al.*, 2004). The ventral placement of spiracles on A4-6 has not been reported in other genera.

Inspection of prominent dorsal intersegmental clefts at the junctions of A4/5 and A5/6 (Fig. 5) revealed a stridulatory plate consisting of a honeycomb of polygonal ridges near the posterior margin of the cephalad segment (Fig. 10) and a facing file of raised teeth near the anterior margin of the caudad segment (Fig. 11) of each segment pair, similar to those reported for various lycaenids and riodinids (Downey, 1966; Downey & Allyn, 1973 and 1978; Nishida, 2010; see also Álvarez *et al.*, 2013). Further inspection revealed that the stridulatory organs continue ventrally and encircle the relevant segments, as reported for some other riodinids (Downey, 1966). The inverted bowl structure of fused segments A8-10 may serve as a resonating chamber to amplify stridulations.

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